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Looking for evidence of change: Evaluation in the Teaching Teachers for the Future project

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Abstract: Commitment of substantial government funding to a project brings with it a requirement for evaluation of the degree to which the project has succeeded in achieving its stated goals. The *Teaching Teachers for the Future* (TTF) project funded by the Australian Government has developed an evaluation plan using both quantitative and qualitative methods. This paper recounts some aspects of the development of the evaluation plan, describes the methods being used, and presents some insights from preliminary analysis of the data for one of the 39 teacher preparation institutions participating in the TTF.

Introduction

In late 2007 Australia elected a Government that included in its platform an initiative dubbed the Digital Education Revolution (DER), which was intended to achieve a national vision for Information and Communication Technology (ICT) in schools (DEEWR, 2008). That vision, for students to graduate with relevant knowledge and skills for using ICT and for learning to be improved by integration of ICT, had been articulated at the beginning of the century but had been mostly left to the states and territories to implement separately. The DER represented a commitment to implementing the vision at a national level and one of its most visible elements was funding to increase the provision of computers in schools to a ratio of 1:1 for years 9 to 12 by 2011.

Although the initial and most widely visible thrust of the DER was provision of equipment, the implementation roadmap recognized that "educators require the pedagogical knowledge, confidence, skills, resources and support to creatively and effectively use online tools and systems to engage students" (AICTEC, 2009, p. 6). That document referred to providing "professional learning opportunities for existing teachers to upgrade or develop proficiency in the effective and innovative/creative educational use of ICT" and ensuring "that the national graduate teacher standards include rigorous requirements regarding the use of technology in teaching" (AICTEC, 2009, p. 8). In 2010 funding was made available through an ICT Innovation Fund for projects to improve the capabilities of pre-service and in-service teachers for working with ICT and to build the capacity of school leaders to support ICT integration (DEEWR, 2010).

Teaching Teachers for the Future (TTF) was the successful bid for the ICT Innovation Fund element targeted to pre-service teacher education. A group acting on behalf of the Australian Council of Deans of Education led the bid and its implementation involves all thirty-nine Australian higher education institutions that prepare teachers. TTF comprises three components, namely, extension of the graduate teacher standards being developed by the Australian Institute for Teaching and School Leadership (aitsl.edu.au) to include ICT dimensions, development of professional learning packages demonstrating how ICT can be integrated in the first four subjects of the new Australian curriculum (ttf.edu.au), and development of a National Support Network (NSN) to drive systemic change in the treatment of ICT in teacher education. The third component provided funding to each of the participating institutions to employ for one year the equivalent of an additional person with experience in classroom integration of ICT and to release a senior academic half-time to manage the project within each institution. Discussions during the development of the TTF proposal identified Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006; Thompson & Mishra, 2007) as a useful framework for talking about the development of pre-service teachers' capabillities for working with ICT. TPACK was adopted as the underlying framework for the TTF project and is informing the development of packages in the second component and the work of the NSN.

The TTF proposal included a commitment to evaluation of each of the three components. For the first component, the extension to the national professional standards for graduate teachers, the commitment was to a trial of the dimensions and associated evidence guides in teacher education programs participating in the third

component, followed by refinement of the dimensions for eventual wider application. For the second component, the exemplar packages, an independent evaluator was appointed and the evaluation was to include trial of the packages in participating programs and collection of data from participants through questionnaires and interviews.

Given that the central goal of the TTF project is to build the ICT in Education (ICTE) proficiency of graduate teachers and that the majority of the funding and effort toward that goal has been committed in the third component, the focus of evaluation for the third component was to be changes in the ICTE capabilities of pre-service teachers. Because the TPACK framework has informed the TTF project to the extent that the project documents speak of developing TPACK capacity, it was natural for the evaluation to focus on changes in TPACK. To plan and manage the evaluation of the third component across thirty-nine institutions, a Research and Evaluation Working Group (REWG) was established with representation from multiple participating sites and additional members with relevant expertise drawn from the Australian Association for Research in Education (AARE).

Measurement of TPACK

The TTF project involves 39 institutions that enroll several thousand pre-service teachers in teacher preparation programs. Obtaining comparable measures of TPACK on that scale presents significant logistical challenges and ideally would be done using a method that is known to be valid and reliable. A method suitable for online administration to large numbers of respondents would be a convenient solution for the TTF project with its requirement to collect data from several thousand pre-service teachers at sites around Australia.

In a review of methods and instruments for measuring TPACK, Abbitt (2011) reported that he located 33 studies that included an assessment of TPACK and that 20 of those had been conducted in the context of pre-service teacher programs. Another review reported identifying 141 instruments that measured some aspect of TPACK (Koehler, Shin, & Mishra, 2011). Despite this apparent plethora of instruments for measuring TPACK or some aspects of it, there appears to be no widely accepted instrument that has emerged as the obvious choice.

Attempts to measure TPACK date from the earliest writing on the framework. Koehler and Mishra (2005) asked 17 participants about their perceptions the TPACK model elements during a design course. The analysis showed that participants increased their thinking about all seven TPACK elements during the course. A subsequent study with 24 participants (Koehler, Mishra, & Yahya, 2007) using a similar design traced development of TPACK elements, confirming the development of stronger interconnections among the initially separate topics of technology, content and pedagogy over time. These studies demonstrated the development of TPACK over time but did not provide a methodology for measurement of TPACK with larger groups.

Despite the apparent enthusiasm for TPACK as a framework for thinking about teachers' work with ICT, Graham (2011) has argued that there is still considerable variation in the understanding of TPACK and its component elements. In his view the published research on TPACK has weaknesses in relation to criteria for theory building that suggest a need for increased effort by researchers to build common definitions. One of the key issues identified by Graham relates to whether the areas of intersection in the TPACK framework diagram should be understood as integrative or transformative. He notes that, although the diagram suggests an integrative model in which elements such as Technological Pedagogical Knowledge (TPK) represent a combination or mixture of Technological Knowledge (TK) and Pedagogical Knowledge (PK), the language used by Mishra and Koehler (2006) implies a transformative understanding in which TPK is a distinct form of knowledge that is not merely the sum of its parts. In the absence of agreement among researchers on this and other aspects of the theory it is difficult to imagine how it could be possible to construct a satisfactory method of measurement for TPACK.

Lack of common understanding of the TPACK constructs among researchers may have contributed to the emergence of variations in the models used as the basis for development of instruments in some studies. Angeli and Valanides (2009) proposed ICT-TPCK as a strand within TPCK and used a combination of peer, expert, and self-assessment demonstrated in two design tasks guided by a list of criteria to assess the TPCK of 215 pre-service elementary teachers in 3 separate semester cohorts. They reported that students' total ICT-TPCK increased from the first task to the second. The similarities between ICT-TPCK and the general TPACK framework are sufficient that the criteria used in this study could be adapted for wider use but the method of task-based assessment of individuals would not be scalable to a project such as TTF. Lee and Tsai (2010) proposed TPCK-W as a variation of the TPACK framework in which the World Wide Web was the focal technology. Although this study may have lessons about the process of constructing an instrument to measure TPACK, its narrowed focus on Web technology makes it unsuitable for application in the TTF project.

Even when the TPACK framework is used in its generic form without variations such as those described above (Angeli & Valanides, 2009; Lee & Tsai, 2010), there is liable to be some degree of specificity around the content being learned or the technology being deployed. These factors present challenges for development of

instruments that are both general enough to be useful in different contexts and specific enough to avoid vague generalities. A 24 item questionnaire was developed for use with K-12 online educators using processes including review by an expert panel and a think-aloud pilot to ensure construct validity and consistent interpretation of items (Archambault & Crippen, 2009). Analysis of data from 596 respondents indicated that the instrument was valid and reliable but the items are specific to online education and not suitable for wider use without modification.

Graham, Cox, and Velasquez (2009) considered self-report and performance-based assessment of artifacts as methods for measuring TPACK development in pre-service teachers. They noted that performance assessment is time consuming and unsuitable for use with large groups or when a quick result is required and that questionnaires suffer from difficulties in framing questions to address the TPACK constructs and inconsistent interpretation by respondents. They developed a questionnaire to measure TPACK constructs but reported that items did not load as expected in factor analysis. Another study using a questionnaire to measure TPACK confidence of science teachers (Graham, Burgoyne, et al., 2009) addressed only the four technology-related elements (TPCK, TPK, TCK, and TK) of the TPACK framework with the content-related items linked to science. They reported significant increases in each element from start to finish of an intensive professional development program but the small number of participants did not permit tests for construct validity of the instrument.

A community of researchers interested in the TPACK framework is developing and the TPACK website (www.tpck.org) provides one focal point for activity including approaches to the measurement of TPACK. An instrument available from that website comprises items developed from the framework and subjected to construct validity checks by an expert panel before being administered to 87 elementary pre-service teachers (Schmidt, et al., 2009). The scales attributed to the various elements of the TPACK framework returned Alpha reliability values that ranged from 0.75 to 0.92, suggesting that the instrument is reliable and could be used confidently where the elementary subjects represented in the content scales are appropriate.

Although it would be desirable to have a direct measure of teachers' TPACK, performance-based measures are not practicable for large numbers and self-report measures are also problematic (Graham, Cox, et al., 2009). There is good evidence that teachers' behaviors with ICT are strongly influenced by their related levels of confidence (Ertmer & Ottenbreit-Leftwich, 2010). Hence there would be value in the development and use of self-report instruments to measure teachers' confidence to perform TPACK-related behaviors in the expectation that higher levels of such confidence would be related to increased performance of the behaviors. The *TPACK Confidence Survey (TCS)* was developed to audit the TPACK confidence of final year pre-service teachers at two Australian universities (Albion, Jamieson-Proctor, & Finger, 2010). The 20 items used to measure TPACK confidence had been developed and validated in a previous study of ICT integration in schools in which teachers had been asked to indicate how often students in their classes used ICT for a variety of learning tasks (Jamieson-Proctor, Watson, Finger, Grimbeek, & Burnett, 2007). For the *TCS* the items were modified to ask pre-service teachers to indicate their level of confidence for facilitating such use by students in their classes, thereby indicating their levels of confidence for performing TPACK-related behaviors (Albion, et al., 2010).

TTF Project Evaluation Plan

The leaders of the TTF project were aware of the prior work with the *TCS* (Albion, et al., 2010) and recruited the authors, who were already involved with the project in their own institutions, to the REWG with the intention of using the TCS as the basis of an instrument to measure change in TPACK-related capabilities. The REWG had one face-to-face meeting but otherwise worked by teleconference and email from January to April 2011 to develop the necessary instruments and protocols. It included members experienced in Rasch and other forms of analysis who conducted some analysis of items used in the *TCS* study and made a strong case for ensuring that any instrument would include items likely to attract a range of responses from students. Hence the REWG began by developing a varied collection of about 100 potential items with a focus on the elements of the TPACK framework that included technology (TK, TPK, TCK, and TPCK). Through discussion and successive rounds of editing this collection was reduced so that the core of the final questionnaire comprised 56 items classified as TPK (24), TCK (8), and TPCK (24, including 20 items carried over from the *TCS*). When complete the questionnaire also included parallel scales using the same items to assess pre-service teachers' perceptions of the future usefulness of the TPACK-related behaviors. Table 1 displays sample items developed for each of the sections with the relevant stems for the confidence scales. For the TPK items the usefulness stem was "How useful do you consider it will be for you, as a teacher, to be able to use ICT to …". Equivalent changes were made to construct the usefulness scales for the other sets of items. Both sets of items were presented using 7-point scales with anchors at 0 (Not confident, Not useful), 3 (Moderately confident, Moderately useful), and 6 (Extremely confident, Extremely useful) with an additional non-scoring alternative labeled as "Unable to judge". In addition to the confidence and usefulness scales

described above, the final questionnaire included a range of demographic items and an additional 9 items related to the extensions to the graduate standards being developed in the first component of TTF.

Technological Pedagogical Knowledge (TPK)
How confident are you that you have the knowledge, skills and abilities to use ICT to …
Demonstrate knowledge of the range of ICT to engage students
Access, record, manage, and analyze student assessment data
Technological Content Knowledge (TCK)
How confident are you that you have the knowledge, skills and abilities to …
Design learning sequences, lesson plans and assessment that use ICT to develop students' Mathematics knowledge, attitudes and skills
Implement meaningful use of ICT by students in achieving Mathematics curriculum goals
ICT integration - TPCK
How confident are you that you have the knowledge, skills and abilities to support students' use of ICT to …
Demonstrate what they have learned
Integrate different media to create appropriate products

Table 1: Sample items from the core groups in the instrument

The TTF project was approved for funding from the beginning of 2011 until mid-2012 but complications in the project arrangements delayed the release of funding until April 2011. As a consequence the work of the project did not begin in most institutions until April 2011, thereby delaying the date at which pre-test data could be collected. Because the funding conditions required final reports to be submitted in June 2012 it was thought impractical to attempt to collect and analyze post-test data in 2012, leaving late 2011 as the only time available for administration of the post-test questionnaire. The effect of a TTF intervention on pre-service teachers was expected to be limited by the combination of a late start to the project and its interventions, the short time between pre-test and post-test, and the variations in programs among institutions that would affect what, if any, intervention could occur between pre-test and post-test. These factors and commitment to seeking alternative forms of evidence led the REWG to consider additional approaches to evaluation. The Most Significant Change (MSC) technique (Dart & Davies, 2003) was adopted as a suitable methodology for collecting a wider range of data about any possible effects of the TTF project on teacher preparation programs.

Data Collection and Analysis

The questionnaire was presented online using Qualtrics (www.qualtrics.com) software, which supported tailoring of demographic questions according to enrolment so that respondents saw only the choices about campus, program and course that applied to their institution. Once the questionnaire was ready in late April 2011, coordinators at each of the participating institutions arranged to issue email invitations to all students enrolled in their teacher preparation programs. The administration schedule varied by institution because of factors including assessment periods, delays in obtaining ethical clearance, and students being absent on professional experience. The period of availability of the questionnaire was ultimately extended to July to accommodate these differences. In total 10433 complete or partially complete responses were collected.

Analysis of the national data set is being undertaken by a team with experience in analysis of complex datasets and will include comparison among groups of participants, including institutions, which can be distinguished according to responses to demographic and other items in the questionnaire. Participating institutions have been provided with summaries of responses for the national set and for their own institutions and with the individual responses for their own institution. The results presented in this paper are based on the national summary and the data provided for one Queensland regional university. They represent preliminary analyses and may be subject to adjustment following completion of the analyses being conducted nationally.

Table 2 presents results from the national dataset and for the one university. Means have been calculated for confidence and usefulness on the groups of items originally identified as representing TPACK elements. This analysis has been conducted on the raw data prior to the national analysis confirming (or not) the structure of the instrument. The means obtained for the regional university were significantly higher than the national means (Z-test, $p < 0.01$) for five of the six measures. Inspection of the results for individual items in the scales revealed that the means for the regional university were higher than the national means on all item and significantly higher (Z-test, $p < 0.01$) for 39 of the 56 items and 32 of the 56 items on the confidence and usefulness scales respectively.

		National			University					
	Item group	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**Z**	**p**	
Confidence										
	TPK	9422	4.01	1.40	508	4.24	1.34	3.72	<.001	*
	TCK	6304	3.81	1.45	390	4.01	1.38	2.70	.003	*
	TPCK	8816	3.99	1.38	486	4.13	1.32	2.41	.008	*
Usefulness										
	TPK	9416	5.15	1.11	508	5.29	1.00	3.04	.001	*
	TCK	6218	5.26	1.06	390	5.32	1.02	1.07	.142	
	TPCK	8809	5.11	1.11	485	5.23	1.02	2.45	.007	*

Table 2: Mean scores on subscales for national and university datasets (* = significant at 1%)

The regional university in this study had participated in previous studies (Albion, et al., 2010) that included 20 items from the *TCS* subsequently incorporated in the TPCK subscale of the TTF instrument. Hence there was the possibility of examining trends in responses to those items by comparing results from the 2009 and 2010 questionnaires with the 2011 dataset. Table 3 presents results from those 20 common items for the 2011 datasets from the national pool and the regional university together with values for Z and estimates of the probability. Although, as shown in Table 2, the university mean on the TPCK subscale is significantly higher than the national mean ($Z = 2.41$, $p = .008$), the means on just 9 of the 20 items are significantly higher ($p < 0.01$).

	How confident are you that you have the knowledge, skills and abilities to support students' use of ICT to …	National (N = 8816		University (N = 486)				
		M	**SD**	**M**	**SD**	**Z**	**p**	
1	provide motivation for curriculum tasks	4.12	1.32	4.23	1.25	1.98	.024	
2	develop functional competencies in a specified curriculum area	3.82	1.35	3.99	1.31	2.84	.002	*
3	actively construct knowledge that integrates curriculum areas	3.93	1.35	4.07	1.32	2.31	.011	
4	actively construct their own knowledge in collaboration with their peers and others	3.99	1.34	4.07	1.28	1.36	.087	
5	synthesise their knowledge	3.80	1.39	3.93	1.32	2.14	.016	
6	demonstrate what they have learned	4.18	1.34	4.31	1.28	2.22	.013	
7	acquire the knowledge, skills, abilities and attitudes to deal with on-going technological change	4.09	1.41	4.24	1.35	2.29	.011	
8	integrate different media to create appropriate products	3.87	1.43	4.00	1.38	2.04	.021	
9	develop deep understanding about a topic of interest relevant to the curriculum area/s being studied	4.07	1.32	4.17	1.30	1.70	.045	
10	support elements of the learning process	4.05	1.32	4.20	1.27	2.57	.005	*
11	develop understanding of the world	4.23	1.31	4.36	1.22	2.28	.011	
12	plan and/or manage curriculum projects	4.03	1.37	4.20	1.32	2.74	.003	*
13	engage in sustained involvement with curriculum activities	3.98	1.36	4.17	1.33	3.04	.001	*
14	undertake formative and/or summative assessment	3.97	1.42	4.16	1.37	2.87	.002	*
15	engage in independent learning through access to education at a time, place and pace of their own choosing	4.06	1.41	4.26	1.36	3.06	.001	*
16	gain intercultural understanding	3.87	1.37	4.03	1.32	2.42	.008	*
17	acquire awareness of the global implications of ICT-based technologies on society	3.81	1.40	3.93	1.34	1.84	.033	
18	communicate with others locally and globally	4.34	1.38	4.50	1.27	2.62	.004	*
19	understand and participate in the changing knowledge economy	3.79	1.45	4.05	1.35	4.09	<.001	*
20	critically evaluate their own and society's values	3.90	1.39	4.01	1.33	1.68	.046	

Table 3: National and regional university 2011 results for selected TPCK subscale items (* = significant at 1%)

The questionnaire administered in 2009 and 2010 used a 4-point scale scored from 1 to 4 with anchors of 'No confidence', 'Some confidence', 'Confident', and 'Very confident'. That was different from the 7-point scale described above for use in the 2011 questionnaire. Hence comparison of trend data first required conversion of data to comparable scales. Table 4 presents the 4-point and 7-point scales aligned to show how the 2011 data were converted to the 4-point scale by recoding with half-points inserted. Alternative conversions using the anchor points to establish linkages were considered but discarded because they appeared to inflate the converted scores making the differences appear larger than for the conversion shown in Table 4 which was preferred as more conservative.

2011 National scale	Not confident			Moderately confident			Extremely confident
	0	1	2	3	4	5	6
2009-10 University scale	1	1.5	2	2.5	3	3.5	4
	No confidence		Some confidence		Confident		Very confident

Table 4: Conversion of 7-point scale to 4-point scale for comparison

Table 5 presents comparative results for the 20 common questions included in the TPACK confidence instruments administered in 2009, 2010 and 2011. Average scores for the 20 items in each of the questionnaires are also included at the foot of the table and Z scores and P values are included for the 2009-2010 and 2010-2011 comparisons. There were no significant differences found between scores recorded in 2009 and those recorded in 2010. In contrast, using the conversion from 7-point to 4-point scale shown in Table 4, the mean scores for all items were significantly higher ($p < 0.01$) in 2011 than in 2010.

	How confident are you that you have the knowledge, skills and abilities to support students' use of ICT to …	2009 (N = 136)		2010 (N = 450)				2011 (N = 486)				
		M	**SD**	**M**	**SD**	**Z**	**P**	**M**	**SD**	**Z**	**P**	
1	provide motivation for curriculum tasks	2.94	.70	2.93	.73	-.15	.885	3.11	.62	2.80	.003	*
2	develop functional competencies in a specified curriculum area	2.76	.75	2.76	.75	<.01	.999	3.00	.66	3.34	<.001	*
3	actively construct knowledge that integrates curriculum areas	2.86	.74	2.79	.76	-.96	.338	3.03	.66	3.46	<.001	*
4	actively construct their own knowledge in collaboration with their peers and others	2.88	.69	2.86	.75	-.29	.774	3.04	.64	2.65	.004	*
5	synthesise their knowledge	2.86	.73	2.78	.74	-1.11	.265	2.96	.66	2.65	.004	*
6	demonstrate what they have learned	3.04	.66	2.94	.74	-1.50	.134	3.15	.64	3.34	<.001	*
7	acquire the knowledge, skills, abilities and attitudes to deal with on-going technological change	2.72	.77	2.76	.79	.52	.600	3.12	.67	4.90	<.001	*
8	integrate different media to create appropriate products	2.63	.87	2.71	.83	.94	.346	3.00	.69	3.58	<.001	*
9	develop deep understanding about a topic of interest relevant to the curriculum area/s being studied	2.90	.76	2.86	.75	-.54	.589	3.09	.65	3.15	.001	*
10	support elements of the learning process	2.93	.69	2.90	.72	-.44	.660	3.10	.63	3.06	.001	*
11	develop understanding of the world	2.75	.75	2.74	.78	-.13	.893	3.18	.61	6.25	<.001	*
12	plan and/or manage curriculum projects	2.88	.72	2.82	.76	-.84	.402	3.10	.66	4.08	<.001	*
13	engage in sustained involvement with curriculum activities	2.81	.74	2.79	.76	-.27	.784	3.08	.66	4.18	<.001	*
14	undertake formative and/or summative assessment	2.96	.71	2.91	.8	-.70	.486	3.08	.69	2.45	.007	*
15	engage in independent learning through access to education at a time, place and pace of their own choosing	2.87	.76	2.82	.75	-.68	.498	3.13	.68	4.29	<.001	*
16	gain intercultural understanding	2.81	.77	2.81	.76	<.01	.999	3.01	.66	2.78	.003	*
17	acquire awareness of the global implications of ICT-based technologies on society	2.60	.82	2.61	.80	.13	.900	2.97	.67	4.63	<.001	*
18	communicate with others locally and globally	3.09	.73	3.02	.74	-.97	.332	3.25	.64	3.31	<.001	*
19	understand and participate in the changing knowledge economy	2.66	.76	2.66	.79	<.01	.999	3.03	.67	5.05	<.001	*
20	critically evaluate their own and society's values	2.75	.74	2.76	.77	.14	.892	3.01	.67	3.46	<.001	*
	Mean score	2.84	.74	2.81	.76	-.32	.749	3.07	.66	3.69	<.001	*

Table 5: Trends in regional university scores for common TPCK items across 2009-2011 (* = significant at 1%)

Respondents to the 2009 questionnaire were all students in the final year of their teacher education programs but respondents in 2010 and 2011 included students at all stages in their programs. Those datasets were analyzed using ANOVA with the TPCK subscale score as the dependent variable and responses grouped by stage in the program. Because the questions about progress in the program were asked differently in 2010 and 2011, the groups were not directly comparable but it was possible to identify students according to relative time from completing their program. There were significant differences ($p < .05$) found between groups for both the 2010, [$F(3, 425) = 8.44$, $p < .000$], and 2011, [$F(5, 498) = 2.246$, $p = .049$], respondents. Post hoc tests revealed that respondents in the final year of their program reported the highest mean scores.

Discussion

As described above, preliminary analysis of data from the national questionnaire suggests that, for students in the regional university, the mean self-rated confidence for performing TPACK-related behaviors is significantly higher than the national average for their peers in other teacher preparation institutions. That preliminary finding is subject to confirmation when the results of the national analyses of the data are available. The national analysis will establish the characteristics of the instrument used for data collection and will include cross-institutional and other comparisons that will explore any significant differences between identifiable groups within the national sample. In the meantime there is value for the regional university in considering what significance the differences revealed in the questionnaire data may have for the teacher preparation program and its development.

Of the six subscales reported in Table 2, respondents from the regional university reported significantly higher means on five, including all three for confidence related to various elements of TPACK. The implication is that, compared to students in other teacher preparation programs, students at the regional university feel better prepared for working with ICT in their future classrooms. This is a positive outcome for the teacher preparation programs at the regional university and, to the extent that teachers' confidence levels influence their use of ICT in their, it is an indicator of potential for enhanced use of ICT in those classrooms.

The significantly higher means on the 20 items of the TPCK confidence subscale found for respondents in the final year of their teacher preparation program confirm that confidence increases during the program of study. Although it is possible that some of the increase might be related to maturation or other factors unrelated to the teacher preparation program, it seems likely that much of the increase is attributable to experiences within the program, which includes both a specific course on *ICT and Pedagogy* and a variety of other experiences of ICT used for learning embedded in other courses.

The apparent increase in means on the 20 common items across the 2009 to 2011 period also bears examination. The results presented in Table 5 are for final year students in 2009 and students across all years in 2010 and 2011. Those results show no significant increase from 2009 to 2010 but significant increases on all items from 2010 to 2011. When the data for final year students only are examined there are 6 items with significant ($p < .01$) increases from 2009 to 2010 and 2 with significant increases from 2010 to 2011. However, all 20 items exhibit significant differences ($p < .01$) from 2009 to 2011. The implication is that the mean TPCK confidence of students in the program has been increasing from year to year.

On the basis of this preliminary analysis it appears that the teacher preparation program at the regional university is making a difference to graduates' TPACK confidence as manifested in higher mean scores for final year students, that the extent of that difference has increased over the past three years, and that on average graduates from this university report higher levels of confidence than the average of graduates nationally.

In considering potential explanations for these differences, two factors emerge. One is the reintroduction from 2010 of the *ICT and Pedagogy* course, which is taken by most students in the third year of their fourth year program. Final year students responding to the 2011 questionnaire will have completed that course. A second factor is the offering of all courses entirely online, as well as on the three campuses, from 2009. Although only about 50% of students in any course are studying online, the online offering has affected the way that courses are developed such that all students in the courses are likely to interact with at least parts of the online materials. In doing so they experience learning with ICT in ways that they might not have done in conventionally offered courses and that experience is likely to affect their knowledge of learning and teaching with ICT and their confidence for working with ICT. Those effects may be evident in their increased scores on the TPACK confidence scales.

As noted above, the apparent affirmation of the success of teacher preparation at the regional university in building TPACK confidence awaits confirmation through the analysis being undertaken by the national team. If it does emerge that this university, and others, are more successful at inculcating TPACK confidence as measured by the instrument then identifying practices that contribute to that success may contribute substantially to meeting the

TTF project goals. The short time available for interventions supported by the project reduces the likelihood of identifying valuable practices through differences between pre-test and post-test scores. However, if it may be possible to identify such practices through cross-institutional comparisons and for them to be adopted more widely in appropriate contexts.

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